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ABSTRACT

Identification of psychological factors influencing team performance in the chemical, biological, and radiological defense (CBR-D) environment were identified by a system for task classification: (1) combining Herold's task demands and Holland's taxonomy of work environments and (2) describing the development and evaluation of team tasks. This report evaluates the new system and describes the development and evaluation of a team task that meets the criteria specified. The criteria include: (1) allow variation in group performance, (2) require the coordination of the efforts of individuals in the group, (3) is susceptible to disruptions due to stress, (4) is classifiable by an acceptable task taxonomy, and (5) is familiar and interesting. Many stresses experienced by the group working as a Realistic task could result from incompatible personalities within the group rather than by threats external to it. It is important to separate these sources of stress in order to isolate and deal with them. These findings contribute to the work on team effectiveness and gives the Navy practical guidelines for enhancing team performance in CBR-D environment. (RR)

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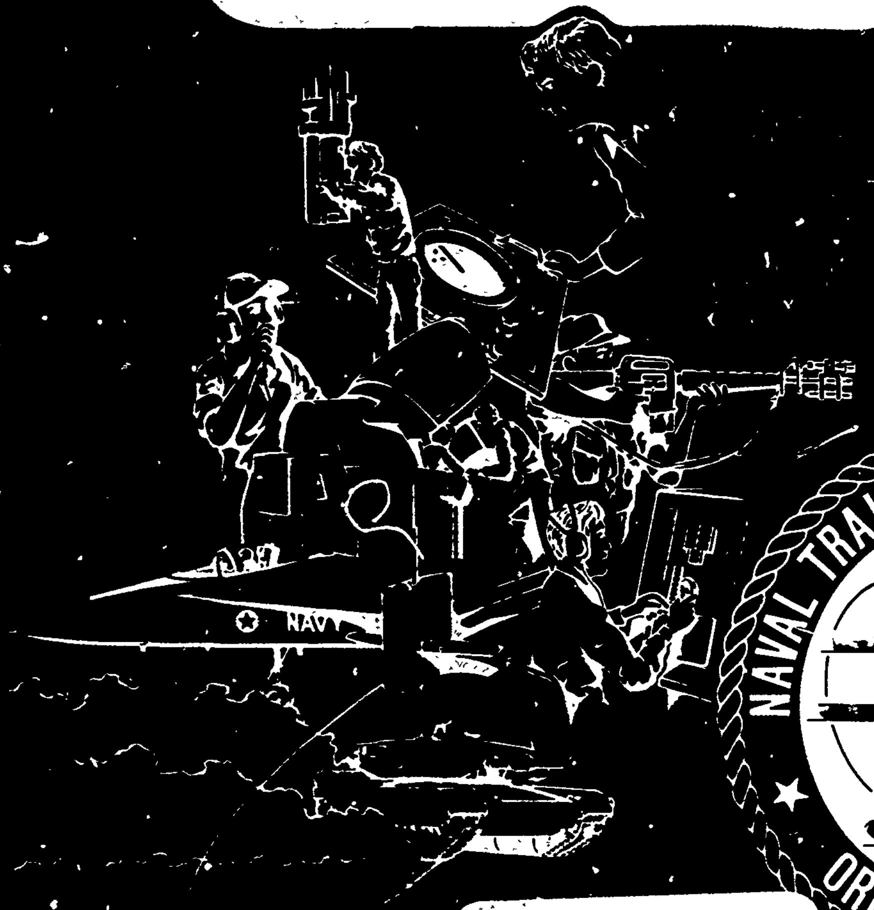
EFFECTIVE TEAM PERFORMANCE IN MILITARY ENVIRONMENTS



NTSC TR86-021

EFFECTIVE TEAM PERFORMANCE IN MILITARY ENVIRONMENTS

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The Human Factors Division of the Naval Training Systems Center is interested in identifying psychological factors that influence team performance in the CBR-D environment. The adoption of a system to classify tasks that may be studied and the development and pilot testing of a team task that can be used to evaluate group performance are prerequisites to the identification of such factors.

This Technical Report (a) evaluates a new system of task classification consisting of a combination of Herold's task demands and Holland's system of classifying work environments; and, (b) presents the development and evaluation of a team task.

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Dr. Charles Morris of the University of Michigan provided the project with 27 tasks, rated on difficulty, interest, and familiarity, from his 1965 work on task classification. He also contributed many useful ideas concerning the dimensions of task classification.

Dr. Eduardo Salas of NAVTRASYCEN contributed many useful suggestions regarding how to conduct the reliability studies as well as items for task classification.

Each of these persons also encouraged us in the notion that reliable task classification is a sine qua non for reliable and ultimately valid research considering the effectiveness of small groups.

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Summary

The Human Factors Division of the Naval Training Systems Center is interested in identifying psychological factors that influence team performance in the CBR-D environment. The development of a system for classifying team tasks, and the construction and pilot testing of a team task to evaluate team performance, would facilitate the identification of these factors.

This Technical Report (a) evaluates a new system of task classification that combines Herold's task demands and Holland's taxonomy of work environments; and, (b) describes the development and evaluation of a team task that meets the following criteria:

(1) It allows variation in group performance.

(2) It requires the coordination of the efforts of the individuals working in the group.

(3) It is susceptible to disruption by stress.

(4) It is classifiable by an acceptable task taxonomy.

(5) It is familiar and interesting.

Task Classification

We propose a set of criteria for a task taxonomy that requires exclusive, exhaustive, and logical task categories, that is appropriate for applied as well as laboratory tasks, that is applicabl to problems beyond task classification, and that is based on a theoretical model. We review all existing task classification systems and evaluate them in

terms of the foregoing criteria. We conclude that no existing system fully meets the criteria; that our proposed system meets the criteria, and can be used reliably to classify a wide variety of tasks.

The new task classification system (a) is most reliably used by persons familiar with the Holland taxonomy of work environments, (b) can predict the social demands of a task, (c) is related to the skills necessary effectively to perform a task, and (d) is somewhat affected by the sex of the rater. Results suggest that users of the proposed task taxonomy be trained prior to classifying tasks and that they be of the same sex as the people who will actually perform the task.

Team Task

We propose a team task, a scaled-down simulation of the Navy underway replenishment task, for use in research concerning the factors influencing group effectiveness. Pilot testing of the task indicates that it meets the 5 requirements for a team task and, therefore, would be useful for such research. We offer recommendations for further research using the team task "replenishment at sea".

Approach

The Human Factors Division of the Naval Training Systems Center is concerned with identifying psychological factors that affect individual and team performance in the stressful conditions of the chemical, biological, and radiological defense (CBR-D) environment. This information can then be used to develop training procedures to counteract the negative effects of stress on individual and team performance.

In order to study such factors, it is first necessary to develop and calibrate a team task that can be used to evaluate the performance of groups varying in terms of their composition and susceptibility to stress. To be useful in subsequent research, such a team task should have the following qualities:

1. It should allow for sufficient variation in psychological factors affecting team performance and allow for emergent leadership with the other members of the group serving as followers; the task must also allow for variations in group performance, expressed in terms of a total score.
2. The task must be a team task; the results of the task must be a function of the coordinated efforts of individuals working as a group rather than the sum of the efforts of people working as individuals.

3. The task must be susceptible to disruption by stress--performance must be generalizable to the CBR-D environment; the task must have some subtasks that are well or overlearned and others that require problem-solving, because stress differentially affects such subtasks.
4. The task must fit into an acceptable task taxonomy; this will allow the findings to be integrated with an existing body of knowledge about tasks; the task itself should point to the factors that are important or relatively unimportant in explaining group performance.
5. The task should be familiar and interesting; these two factors are known to affect group performance.

Once developed, the team task must be pilot tested and fine-tuned to insure that it has these five qualities.

The team task should fit into an adequate task taxonomy; if no such taxonomies exist in the literature, then one must be developed and evaluated. General criteria for an acceptable task taxonomy have been outlined by Hackman (1966) and McGrath (1984).

Hackman (1966) specifies two major requirements for an adequate task typology: (a) it must identify "critical behaviors" or classes of behaviors which the tasks require of group members; and (b) it must parsimoniously describe and compare task characteristics. McGrath (1984) argues that the categories of a task classification schema should be (a) mutually exclusive, (b) collectively exhaustive, (c) logically related to one another, and (d) useful in pointing out differences between and relations among the tasks that would not otherwise be noticed.

We suggest three additional criteria. First, a task taxonomy should be able to classify applied as well as research tasks. Traditional group research has focused almost exclusively on laboratory oriented tasks or games which may have limited generalizability. A task taxonomy should encompass both laboratory tasks and those in the "real world." Second, the taxonomy should have "construct validity." For example, it might allow one to specify training needs or to recommend other interventions to improve performance. Finally, an adequate task taxonomy should be theory-based. If group effectiveness research is to move beyond a piece-meal approach, it must be guided by theory, not brute empiricism.

McGrath and Altman (1966) suggested that tasks could be classified on any of several different bases: (a) behaviors elicited by the task; (b) behaviors required by the task; (c) physical/environmental properties of tasks qua tasks; (d) relations among group members -- interdependencies or lack thereof; and (e) task goal or product. These classification schemas provide another basis by which to evaluate and compare task taxonomies.

Table 1 outlines the existing task taxonomies and evaluates them in light of the 9 criteria and 5 classification schemas discussed above.

Carter, Haythorn, and Howell (1950) classified tasks into six types: clerical, discussion, intellectual construction, mechanical assembly, motor coordination, and reasoning. Tasks are thus distinguished on the basis of critical behaviors or activities that are required to complete the task.

Shaw (1976) published the first systematic classification of group task characteristics. His system is the most widely researched of the available classification methodologies. Shaw's six task dimensions were empirically derived through factor analysis and include the following: 1) intellective vs. manipulative, 2) task difficulty, 3) intrinsic interest, 4) population familiarity, 5) solution multiplicity vs. specificity, and 6) cooperation requirements. Shaw has derived a set of dimensions for classification rather than a typology. Nonetheless, it might be possible to turn these dimensions into a typology.

Hackman's classification scheme (derived using factor analysis) included production, discussion, and problem-solving tasks (Hackman & Morris, 1975, 1978), and is used primarily to classify intellectual tasks with written products.

Steiner (1972) distinguished between tasks that are divisible and tasks that have only a single outcome or product. He further divided unitary tasks into disjunctive, conjunctive and additive tasks in which performance depends on the talents of the best, worst,

Table 1

Characteristics of Existing Task Taxonomies

Criteria	Carter et al. (1950)	Shaw (1976)	Hackman & Morris (1975)	Steiner (1972)	Laughlin (1980)	Herold (1978)	McGrath (1984)
Critical behaviors required	✓		✓		✓	✓	
Parsimous description/comparison	✓	✓	✓	✓	✓	✓	✓
Mutually exclusive		✓				✓	✓
Collectively exhaustive							
Logically related				✓			✓
Point out relations/differences		✓	✓	✓		✓	✓
Applied/basic tasks						✓	
Application beyond						✓	
Theory-based							
Classification Schemas							
Behaviors elicited	✓		✓			✓	
Behaviors required	✓		✓		✓	✓	
Physical/environmental properties		✓					
Group relations		✓			✓	✓	
Task product/goal		✓		✓		✓	

and average member, respectively. Steiner's task classification is directly tied to group productivity.

Laughlin's classification schema (1980) yields two group types: (a) cooperative groups; and (b) mixed-motive and/or competitive groups. Laughlin distinguishes between cooperating groups working on intellective tasks (those with a correct answer) and decision tasks (those with a valued or preferred answer). For the latter groups, he identifies three task types: (a) two-person, two-choice; (b) bargaining-negotiating; and (c) coalition formation. This classification system focuses on group conflict and a restricted domain of tasks.

Herold (1978) suggests that tasks place two general types of demands on a group or individual -- technical and social -- and that these demands may vary from simple to complex or from easy to satisfy to difficult to satisfy. Complexity of technical demands refers to the availability or programmability of the materials, solutions, or data necessary to complete the task. Complexity of social demands refers to the quality of social interaction required effectively to perform the task. In short, Herold's system consists of 2 x 2 model of task demands. Research utilizing Herold's model to classify tasks has been ad hoc, but it shows promise.

The last existing task taxonomy -- the group task circumplex proposed by McGrath (1984)--combines the best of the previous taxonomies. His model is organized around 4 general processes with two task types subsumed within each process as follows: (a) generate alternatives (planning, creativity tasks); (b) choose alternatives (intellective, decision-making tasks); (c) negotiate (cognitive conflict, mixed-motive tasks); and (d) execute (contests/battles, performances). McGrath notes that the eight task types can accommodate virtually all tasks that have been used in prior group research. This represents the taxonomy's greatest strength; on the other hand, it does not address "real world" tasks and its theoretical basis is undeveloped.

Table 1 indicates that none of the existing task taxonomies are fully adequate. Herold's (1978) model meets more criteria than the others; however, its classifications are neither collectively exhaustive nor logically related, and it is not theory based. As a more fully adequate method of task classification, we propose Holland's (1985) system for relating vocational interests and work environments. Holland's system is attractive because: (a) it has been extensively studied and is both reliable and valid when used in the "real world"; (b) it is theory based; and (c) it seems to meet all the criteria for an adequate task taxonomy. Moreover, it provides a way to link tasks with the personalities of the group members. Holland's system has one possible shortcoming; it does not address the specific demands of particular tasks and may, therefore, have limited utility for suggesting training or other interventions intended to improve team performance. We suspect, however, that this shortcoming can be overcome by combining Herold's schema of task demands with Holland's classification system.

Holland's classification system has six categories: realistic, investigative, artistic, social, enterprising, and conventional. Herold's schema has two dimensions: social demands and technical demands. A given task may then be classified in terms of six categories, with two dimensions in each category. In many if not most cases, a task--particularly one drawn from the "real world"--will involve components from two or more categories and will thus be classified in terms of a profile rather than in terms of a single category. For example, a group operating highly technical machinery may involve Holland's realistic and conventional categories and be rated high on Herold's technical demand dimension and low on his social demand dimension.

This combination of Holland's categories and Herold's dimensions of task demands has never been used for task classification; this report presents the results of a series of studies evaluating the utility of this methodology. It also presents the results of a pilot test of a team task which may be useful in research investigating psychological factors that affect group performance.

The first section of this report presents the methods and results of a reliability study using Holland's six categories to classify (profile) 180 tasks. The second section presents the methods and results of a reliability study using skills derived from Holland's categories to profile the demands of 93 tasks and to assess familiarity with and interest in the 93 tasks. The third section presents the results of a comparison of the task profiles derived from Holland's categories with the profiles derived from the underlying skills. The fourth section presents the results of a classification study based on Herold's task demands. The fifth section presents the conclusions drawn from these studies. The sixth section presents our new team task and the results of the pilot studies evaluating its usefulness in this research. The final section presents recommendations for future research using the new team task.

SECTION 1

RELIABILITY STUDY USING HOLLAND'S SIX CATEGORIES

Holland (1985) presents a theory which proposes that people can be classified in terms of six ideal personality types, and work environments can be classified in terms of six model categories. The interests of each personality type correspond to the demands of each environment so that, under optimum conditions, the right person will be found in the right job. Holland's model is normally used to classify people, but he is equally interested in classifying work environments. It seems possible, at least in theory, that his model could be used to classify team tasks. The first study reported here evaluates this possibility. We asked two groups--one familiar and one unfamiliar with Holland's system--to describe a set of tasks using Holland's categories. This resulted in two profiles. We then compared the reliabilities of these profiles. Additionally, we investigated the effects of age, sex, and familiarity with the Holland system on the manner in which the six categories are used.

Method

Subjects

Twenty-four people (16 males and 8 females) with a mean age of 33.4 (standard deviation = 9.4, range 23 to 60) who were familiar with the Holland system constituted the Expert Group. Sixty people (24 males and 36 females) with a mean age of 21.4 (standard deviation = 6.0, range 17 to 46) who were unfamiliar with Holland's system constituted the Naive Group.

Tasks

A total of 180 tasks were used for this study. Thirty-five group tasks were selected from the small group literature. The authors wrote an additional 145 tasks that: (a) were distributed across Holland's six categories, (b) a portion of which were typically done by Navy teams, and (c) half of which could be individual tasks. This consideration was intended to insure that the classification system was generalizable to both group and individual tasks. The tasks were typed on 3 x 5 cards and presented to the subjects.

Procedure

To ease the classification task, we divided the Expert Group, the Naive Group and the 180 tasks randomly into three subgroups. The 3 subject subgroups, composed of 8 Experts and 20 Naive persons, were then randomly paired with the 3 task subgroups, each composed of 60 tasks. The subjects worked individually while classifying their 60 tasks; each subgroup of tasks was thoroughly shuffled before being given to each subject in order to eliminate potential serial effects.

Each subject read a brief description of Holland's six categories (Appendix A), and the instructions and examples for sorting tasks (Appendix B), and was then asked if he/she had any questions concerning either the six categories or the profiling instructions. The subjects sorted the tasks into profiles using Holland's categories. The profiling form asked the subject to write the task number on the form and to distribute 10 points across the six Holland categories for each task to indicate what proportion of each task belonged to each category.

Results

To determine the reliability of this profiling procedure, we computed the mean intraclass correlation coefficients for the three groups of experts and the three groups of students, and then estimated the number of raters required to obtain a reliability coefficient of .90 for each of the six categories. The results are presented in Table 2. The reported intraclass correlation coefficient is the agreement of one rater with raters as random effects (ICC 2,1); the number of raters necessary to obtain a .90 reliability coefficient was computed using the Spearman-Brown Prophesy formula. The artistic, realistic and conventional categories were the most reliably rated and the enterprising and investigative categories were the least reliably rated by our sample of raters.

Table 2

Mean Intraclass Correlation Coefficients for Experts and Students and the Number of Raters Necessary for a Reliability of .90 for Holland's Six Categories

	Experts	Number For r=.9	Students	Number for r=.9
Realistic	.61	6	.45	11
Investigative	.38	15	.25	27
Artistic	.70	4	.52	9
Social	.51	9	.36	12
Enterprising	.35	17	.17	44
Conventional	.60	6	.43	9

Raters were more reliable for the realistic, artistic, social, and conventional categories when profiling tasks that were relatively pure (tasks 65% described by one dimension or 85% described by two dimensions) than they were when profiling complex tasks. The mean reliability for the four dimensions for pure tasks was .62, range .73 to .50; the mean reliability for complex tasks was .36, range .41 to .33. Mean reliabilities for pure and non-pure tasks did not differ for the investigative and enterprising categories.

To determine the effects of age on the degree of usage of the dimensions we correlated age with the numerical ratings. The correlations ranged from -.03 to .01 and were non-significant.

To determine the effects of sex and familiarity with Holland's system on the utilization of the dimensions we computed six 2 x 2 analyses of variance. The results are reported in Table 3.

Table 3

Effects of Sex and Familiarity with the Holland System for the Six Holland Categories

	Sex		Familiarity		Interaction	
	F	p	F	p	F	p
Realistic	1.79	.18	.01	.91	.77	.38
Investigative	2.68	.10	39.04	.00	9.58	.00
Artistic	4.00	.05	.02	.90	2.59	.11
Social	.22	.64	4.24	.04	6.69	.01
Enterprising	11.47	.00	6.20	.01	7.12	.01
Conventional	1.48	.22	3.41	.07	9.41	.00

A graphic representation of these results appear in Appendix C. Only the realistic category was unaffected by sex and level of familiarity with Holand's system. The investigative category was significantly affected by familiarity moderated by the interaction of sex and knowledge; students were more likely to use the investigative category, particularly if they were female. Females were more likely to use the artistic category regardless of their level of familiarity with the Holland system. The social category was affected by familiarity moderated by the interaction; experts were more likely to use the social category particularly if they were female. The enterprising category was affected by both sex and familiarity moderated by the interaction; experts and females were more likely to use the enterprising category because naive males rarely used the category. The conventional category was affected by the interaction of sex with familiarity; female experts used the category more than female students.

Appendix D presents a relatively pure task example for each of Hollana's six categories and the task profile. Each of the example tasks, with the exception of "Enterprising", could conceivably be done either by a person or by a group.

SECTION 2

RELIABILITY STUDY USING HOLLAND-DERIVED SKILLS

The first study indicates that people can use the Holland categories to classify tasks, and that they agree among themselves regarding the classifications. The next questi concerns whether the Holland categories convey any useful information regarding the skills necessary to complete the tasks that have been classified. Appendix E shows how we translated Holland categories into skills, using Holland's (1985) book. We prepared a set of instructions and a rating form. We then asked new groups of expert and naive subjects to profile tasks according to the type and degree of skill required to perform them. Finally, we calculated the reliabilities of these profiles and investigated the effects of age, sex and familiarity with Holland's original system on the relative utilization of the six skill categories.

Method

Subjects.

Subjects were 84 psychology undergraduate and graduate students and professors at the University of Tulsa, who were divided into two groups on the basis of their familiarity with Holland's model. Subjects who were familiar with the model were designated as "Experts" (mean age = 35.7 years, SD = 9.4, range 23 to 61 years); those not familiar were designated as "Naive" (mean age = 20.7 years, SD = 2.7, range = 18-31 years). This produced a group of 24 Experts (14 males, 10 females) and a group of 60 Naive subjects (21 males, 39 females).

Procedure

In the previous study 93 tasks were identified as "relatively pure" (as indicated by a mean rating of 6.5 or greater on a 10 point scale for a single Holland category; or a mean rating of 8.5 or greater on a 10 point scale for two adjacent categories). To expedite the rating problem, the tasks were randomly divided into three sets of 31 tasks. Each subject rated only one task set; task set assignment was random. As a result each set was rated by 8 Experts and 20 Naive subjects.

Subjects read a brief description of the six skill types adapted from Holland's model. The six skill types were: 1) Mechanical-technical, (Realistic); 2) Intellectual-analytical, (Investigative); 3) Imaginative-aesthetic (Artistic); 4) Social-interpersonal (Social); 5) Manipulative-persuasive (Enterprising); and 6) Attention to detail (Conventional). Definitions, as noted above, are provided in Appendix E.

Subjects then were given numbered task statements and asked to designate the skill types they thought were necessary for each task. Ten points were distributed across the skill categories (see p. 71). Each rater thus provided a quantitative description or profile of the type and degree of skill necessary to perform each task. In addition, subjects answered two questions for each task: 1) I am familiar with this task (yes/no), and 2) I find this task interesting (yes/no). Familiarity was defined by the experimenter as having previously done a particular task or something very similar. A copy of the rating form is provided in Appendix F. Task statements were shuffled between subjects to avoid order effects.

Results

Three sample tasks and resulting profiles are shown in Appendix G. The mean intraclass correlation coefficients for the Experts and the Naive subjects were computed to determine inter-rater reliability. The reported intraclass correlation coefficient (ICC, 2,1)is the agreement of one individual rater with raters treated as random effects. The number of raters necessary to achieve a .90 reliability coefficient was computed using the Spearman Brown Prophecy formula. Results are reported in Table 4. The mechanical, imaginative, and social categories were the most reliably rated, whereas the intellectual dimension was the least reliably rated by our sample of raters. Overall, the Experts (those familiar with Holland's system) were consistently more reliable raters. The Naive subjects had difficulty reaching agreement on ratings of the intellectual, manipulative, and attention to detail categories.

Table 4

Mean Intraclass Correlation Coefficients for Experts and Students and the Number of Raters Necessary for a Reliability of .90 for Holland Skill Dimensions

	Experts	Number For r=.90	Students	Number For r=.90
Mechanical	.64	6	.64	6
Intellectual	.43	12	.37	16
Imaginative	.73	4	.68	5
Social	.62	6	.54	8
Manipulative	.61	6	.40	14
Atten/Detail	.61	6	.35	17

Table 5

Correlation of Age with Sex, Knowledge and Skill Dimensions

		SEX	KNOWL	MECH	INT	IMAG	SOC	MANIP	DETAIL
AGE	r	.29	-.78	.00	.01	-.02	-.05	.02	.05
	p	.00	.00	.45	.38	.18	.01	.23	.00

Table 6

ANOVA Results for Sex and Knowledge by Skill Dimensions, Task Interest and Task Familiarity

	SEX		KNOWLEDGE		INTERACTION	
	F	p	F	p	F	p
Mechanical	0.78	.38	0.27	.60	1.70	.60
Intellectual	2.25	.13	4.00	.05	13.13	.00
Imaginative	1.50	.22	0.13	.71	0.98	.32
Social	0.97	.33	8.41	.00	0.65	.42
Manipulative	4.34	.04	0.08	.78	1.17	.28
Atten/Detail	0.64	.42	29.20	.00	0.08	.78
Familiarity	0.32	.57	25.47	.00	0.13	.72
Interest	1.65	.20	4.95	.03	0.30	.58

The effects of age upon ratings were explored by correlating age with sex, knowledge, and the ratings for the six skill categories. Results are shown in Table 5. Both sex ($r=.29$, $p = .000$) and knowledge ($r=.78$, $p = .00$) were significantly correlated with age. In addition, the social ($r= -.05$, $p =.01$) and attention to detail ($r=.05$, $p = .00$) categories were significantly correlated with age; although these latter two correlations are statistically significant, they are not substantively meaningful.

To determine the effect of sex and knowledge on ratings of interest, familiarity, and skill dimensions, a series of 2 x 2 analyses of variance were conducted. The results are reported in Table 6. A graphic representation of these results is presented in Appendix H. Only one significant main effect for sex was observed. Males tended to rate tasks as requiring higher levels of manipulative skills ($f = 4.34$, $p = .04$) than did females.

Significant main effects for knowledge were observed for three of the six skill categories (Intellectual, Social, and Attention to Detail) and for both familiarity and interest. We might reemphasize that the knowledge variable (Expert vs. Naive) reflects differences in familiarity with Holland's system of classifying vocational interest. Holland's system does not delineate the 6 skill types rated in this study. Consequently, knowledge effects should be attributed to age, status (professors and graduate students vs. undergraduate students), and life experience differences. Experts were older (mean age = 35.7 yrs) than the Naive subjects (mean age = 20.7 yrs), and are thus likely to have had a greater variety of life experiences.

Use of the Intellectual category was significantly affected by knowledge, moderated by the interaction of sex and knowledge. Experts were less likely to use the dimension, particularly if they were females. Experts also rated tasks as requiring more attention to detail than did the Naive subjects; whereas Naive subjects rated tasks as meeting a greater degree of social skills.

For the dimensions of task familiarity and interest, an inverse relationship exists for Expert and Naive subjects. Experts indicated familiarity with a greater proportion of the tasks (approximately 50% vs. 35% for the Naive subject) and rated the tasks to be less interesting. In contrast, the Naive subjects were less familiar with the tasks but found them to be more interesting.

SECTION 3

COMPARISONS OF HOLLAND CATAGORIES AND SKILLS

At this point, three questions arise that are peripheral to this investigation but nonetheless interesting in themselves. These questions concern the interrelationships among the Holland categories as used by our subjects, the interrelationships among the derived skills categories, and the relationships between the original Holland categories and the derived skills categories. These questions can be answered by computing correlations among these categories using the rating data gathered up to this point. As stated before, the data gathered for the six Holland categories consisted of ratings by 84 subjects for 180 tasks; the data gathered for the six Holland-derived skill types consisted of ratings by 84 subjects for 93 tasks (a subset of the original 180 tasks).

Results

For the six Holland categories, all but one of the intercorrelations were negative and significant at the p=.000 level; the exception was the correlation (r=-.01) between the Social and Enterprising dimensions. The highest negative correlations were found for the Realistic and Conventional dimensions (r's ranging from -.21 to -.29), indicating that these dimensions were least associated with the other four. Results are shown in Table 7. These negative correlations are consistent with Holland's theory, but the magnitude of the coefficients is constrained by the ipsative score format (ten points had to be distributed across six categories).

All of the correlations between the six Holland-derived skill types were significant at the p=.000 level as can be seen in Table 8. All but one correlation were in the negative direction. Social/interpersonal and Manipulative/persuasive skills were positively correlated (r=.33), indicating that when subjects rated a task as requiring Social skills, they also rated the task as needing Manipulative skills.

Correlations between the six Holland categories and the six skill types indicated that each Holland categories was significantly (p=.000) and highly associated with its corresponding skill type. These correlations ranged from .24 to .74, with an average of .49. In addition to the expected correlations between a Holland dimension and corresponding skill type, three others are interesting: (1) Use of the Social category was highly associated, in a positive direction, with ratings for both Social and Manipulative skills, (2) Use of the Enterprising category was positively associated with ratings for both Social and Manipulative skills, and (3) Use of the Conventional category was highly and positively associated with ratings for both Intellectual and Attention to Detail skills. Results are presented in Table 9.

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Table 7

Intercorrelations of Holland's Six Catagories

	REAL	INVEST	ARTIS	SOC	ENTERP	CONVEN
REAL	---					
INVEST	-.26*	---				
ARTIS	-.26*	-.19*	---			
SOC	-.29*	-.15*	-.15*	---		
ENTERP	-.24*	-.12*	-.17*	-.01	--	
CONVEN	-.14*	-.21*	-.29*	-.28*	-.21*	--

*Significant at p=.000

Table 8

Intercorrelations of Holland Derived Skills

	MECH	INT	IMAG	SOCSK	MANIP	DETAIL
MECH	---					
INT	-.22*	---				
IMAG	-.39*	-.24*	---			
SOCSK	-.39*	-.29*	-.08*	---		
MANIP	-.28*	-.15*	-.08*	.33*		
DETAIL	-.11*	-.08*	-.34*	-.31*	-.27*	--

*Significant at p=.000

Table 9

Correlations between Holland's Six Catagories and the Derived Skills

	MECH	INT	IMAG	SOCSK	MANIP	DETAIL
REAL	.64*	-.12*	-.33*	-.27*	-.20*	.04
INVENT	-.16*	.24*	.02	-.00	.02	.05**
ARTIS	-.29*	-.18*	.74*	-.02	-.08*	-.27*
SOC	-.27*	-.09*	-.03	.52*	.41*	-.24*
ENTERP	-.11*	.01	-.07*	.20*	.28*	-.11*
CONVEN	-.02	.21*	-.34*	-.18*	-.18*	.50*

*Significant at p=.000

**Significant at p=.01

SECTION 4

RELIABILITY STUDY USING HEROLD'S TASK DEMANDS

Hackman and Morris (1978) and Ridgeway (1983) suggest that Herold's (1978) scheme for task classification is quite useful. However, little research has actually evaluated the utility of this simple classification scheme (technical vs. social, simple vs. complex). We conducted a study to determine: (a) the degree to which people could reliably classify tasks using Herold's (1978) model; (b) the effects of age, sex, and status on the use of Herold's categories; and (c) the degree to which Herold's model augments the task classification capability of Holland's system.

Method

Subjects

The 84 subjects taking part in this study were described in Section 2 of this report. Designations of "Expert" and "Naive" do not indicate familiarity with or knowledge of Herold's model. This distinction is actually not relevant for this study.

Procedure

One hundred and two tasks that had been previously rated according to Holland's dimensions (Section 1), and were identified as being relatively pure (approximately 50% described by a single dimension), were chosen for this study. To save time, the tasks were divided into three sets of 34. Each task set was sorted by one group of 8 "Experts" and one group of 20 "Naive" subjects.

Subjects read a brief description of Herold's 2 x 2 model of task demands (technical/social by low/high); that description appears in Appendix I. Subjects were then given a set of 34 task statements (typed on 3 x 5 cards) and a box divided and labelled according to the four quadrants in Herold's model: 1) low technical/low social (LTLS), 2) high technical/low social (HTLS), 3) low technical/high social (LTHS), and 4) high technical/high social (HTHS). Subjects were instructed to sort each task according to its most descriptive classification and, therefore, into whichever quadrant of the box they felt it best fit. They also were told that there were no right or wrong answers, and that there did not have to be an equal number of cards in the four areas. No time limit was set. Cards were shuffled between subjects to prevent order effects.

Results

The classification of a task was defined in terms of the modal response of the subjects; 72% (N=73) of the tasks were unimodal and were therefore considered classified. The percentage of tasks classified in each Holland category is shown below in Table 10. Virtually all

Table 10

Classified and Unclassified Tasks by Holland Category

	REAL	INVEST	ART	SOC	ENTERP	CONVEN
CLASSIF	71%	36%	52%	86%	100%	94%
UNCLASS	29%	64%	48%	14%	0%	6%

enterprising, conventional and social tasks could be classified using Herold's model. However, a large proportion of investigative and artistic tasks were unclassified.

The mean intraclass correlation coefficients for the three groups of "Experts", the three groups of "Naive" subjects, and the number of raters required to obtain a .90 reliability coefficient for each of the four Herold classifications is reported in Table 11. The reported intraclass correlation coefficient (ICC 2, 1) is the agreement of one rater with raters treated as random effects. The number of raters necessary to achieve a .90 reliability coefficient was computed using the Spearman-Brown Prophecy formula. The low technical-low social

Table 11

Mean Intraclass Correlation Coefficients for Experts and Naive Subjects and the Number of Raters Necessary for a Reliability of .90 for Herold's Four Dimensions

	EXPERTS	NUMBER FOR r=.90	NAIVE	NUMBER FOR r=.90
LTLS	.43	12	.28	24
HTLS	.36	16	.25	27
LTHS	.34	18	.36	16
HTHS	.34	18	.24	29

(LTLS) and low technical-high social (LTHS) dimensions were the most reliably rated by individual raters; and the high technical-low social (HTLS) and high technical-high social (HTHS) dimensions were the least reliably rated by our sample of raters.

A series of 2 x 2 analyses of variance were conducted to explore sex and status differences in the use of task categories. A graphic representation of these results is presented in Appendix J. One significant main effect was observed for low technical-high social (LTHS) tasks. Experts used the LTHS category more than Naive subjects. A significant interaction effect occurred for high technical-low social (HTLS) tasks. Female Experts classified tasks as HTLS less frequently than did the other subject groups. Another significant interaction effect was observed for HTHS tasks. Female Experts and male Naive raters saw more tasks as being HTHS than did the male Experts or the female Naive raters. Results are shown in Table 12.

Table 12

ANOVA Results for Herold Classifications by Sex and Status

	SEX		STATUS		INTERACTION	
	F	P	F	P	F	P
LoTech/LoSoc (LTLS)	1.86	.17	7.83	.01	0.02	.88
HiTech/LoSoc (HTLS)	0.02	.90	0.46	.50	4.35	.04
LoTech/HiSoc (LTHS)	0.92	.34	3.51	.06	0.17	.59
HiTech/HiSoc (HTHS)	0.09	.76	0.07	.79	3.84	.05

We computed correlation coefficients between age and sex, status, and the four task categories. Age was significantly correlated with sex (r-.31, p=.00), status (r=-.78, p=.00), and LTLS (r=.04, p-.02). The age-sex and age-status correlations are sample specific (male subjects were older than female subjects and experts were older than naive subjects) and the age-LTLS correlation is statistically significant, but not substantively meaningful.

We made the following predictions based on Holland's model, in order to compare the two classification systems:

1) Realistic or Conventional tasks should be LOW SOCIAL

2) Social or Enterprising tasks should be HIGH SOCIAL

3) Artistic or Investigative tasks should be LOW SOCIAL; however, if a group product is specified or implied by the task, task demands should be HIGH SOCIAL.

Predictions of technical demands were made on an individual task basis. The percentages of correct predictions for the possible 2 x 2 classifications as well as for technical vs. social demands are shown in Table 13.

Table 13

Hit/Miss Percentages of Task Classification and Demand Category Predictions

	LTLS	HTLS	LTHS	HTHS	LoSoc	HiSoc	LoTech	HiTec
% HITS	84%	81%	43%	75%	98%	91%	68%	85%
% MISSES	16%	19%	57%	25%	02%	09%	32%	15%
TOTAL N	19	21	21	12	40	33	40	33

The results show that Holland's system can predict the social demands of a task rather accurately. At the same time, however, Holland's system doesn't predict well the technical demands of a task. In this way, therefore, Herold's model adds to or sharpens up Holland's system as a method for classifying tasks. Each of Holland's categories should be qualified by the judgement of whether it entails high or low technical demands.

SECTION 5

CONCLUSIONS

The foregoing studies suggest five conclusions. The first is that raters, regardless of their familiarity with Holland's (1985) RIASEC system of classifying persons and job environments, can use this system to classify team tasks. More specifically, when asked to describe tasks in terms of Holland's categories, raters can do this, and do so with a relatively high degree of agreement. The reliability of this classification depends on the complexity of the task; complex tasks are rated with less reliability than purer tasks, but in over all terms, Holland's model is a useful taxonomic procedure.

Our second conclusion is that the Holland system can be substantially augmented by sorting tasks for high or low technical demands within each of the six primary Holland categories. Moreover, data presented above show that raters can do this with good reliability.

Third, it is well known that team tasks are a primary (if not the primary) determinant of team behavior. Consequently, if one wants to study team performance, it is important to hold team task constant--or to have a method for comparing team tasks across task groups. Here one would want to know if Teams A and B are working on the same or different tasks. The systematic study of team performance depends vitally on a reliable method for classifying team tasks.

Fourth, a combination of Holland's and Herold's systems shows great promise as a method of task classification. It is a method that is theory-based, easy-to-use, reliable, comprehensive, systematic, and exhaustive (cf. Gottfredsen, Holland, & Ogawa, 1982). This, then, gives us a basis for selecting team tasks for use in a series of composed group experiments designed to investigate the effects of personality on team effectiveness. By using this classification methodology we can select tasks that are pure or ideal cases representing each task category and our research will be, by definition, systematic.

Finally, because this classification system allows us to identify the skills necessary for each type of task, it is useful as a guide to training. A task for which training is required may be profiled with this methodology, the relevant skills identified, and this information can be used to enhance the internal validity of the resulting training package.

SECTION 6

TEAM TASK

Our newly derived classification system to evaluate Naval team tasks suggests that many routine shipboard tasks belong in the Realistic category, but that they have varying technical demands. Accordingly, we set out to develop and pilot-test a Realistic team task, beginning with the traditional "underway replenishment" problem. In short, we developed and pilot tested a four-person team task entitled "Replenishment at Sea". The task is a simulation of the Navy problem of transferring materials from a supply ship to another ship, while at sea, using pulleys and a crane. Two shallow boxes (22" wide, 26" long, 3" deep) simulated the ships. These were placed on two standard 5'x 2-1/2' tables spaced 1' apart with the floor between and beside them representing the ocean.

Each "ship" was equipped with (a) a radar station, 18" tall, constructed from erector sets upon which was mounted a single pulley with a rope and hook, (b) a 5" by 5-1/4", 1-1/2" deep cargo transfer platform, (c) a 5" by 2-1/2", 1/2" shallow cargo transfer platform, and (d) a 12 x 15" net which could be placed between the ships. The "Supply Ship" (Ship A) was additionally equipped with (a) 8 rubber wheels and 6 metal bars from erector sets, (b) 50 wooden children's colored building blocks, (c) an 8" x 9" cargo transfer net, and (d) a 2-1/2" tall round bucket 2-1/2" in diameter for cargo transfer. The other ship (Ship B) was additionally equipped with a 2' tall battery operated crane with a 22" extension arm, string and hook for cargo transfer.

The task objective was to transfer the maximum amount of cargo possible from Ship A to Ship B within a 15 minute time limit. The instructions to the team, the rules for cargo transfer, and the point allocation system as revised following the first three pilot groups, is presented in Appendix K.

Method

Subjects

The subjects were 3 four-person groups of males and 2 four person groups of females. Group 1 consisted of 4 male professors, group 2 consisted of 4 male psychology graduate students, group 3 consisted of 4 females (1 professor, 2 psychology graduate students, and 1 psychology undergraduate student), group 4 consisted of 4 male undergraduate students, and group 5 consisted of 4 female undergraduate students. Groups 1 to 3 were selected for their ability to criticize the simulation task and determine whether it met the five required qualities. Groups 4 and 5 were randomly selected from volunteers in an ongoing undergraduate psychology course to test the changes recommended by groups 1 to 3.

Procedure

All subjects read the instructions, rules, and point allocation sheets (Appendix K), had an opportunity to ask questions prior to doing the task, and then were debriefed following task completion. Groups 4 and 5 watched a standardized demonstration of equipment and cargo transfer after reading the instructions but prior to beginning the task--members of groups 1 to 3 expressed the need for such a demonstration. All groups were permitted to distribute themselves between Ship A and Ship B as they saw fit and to use whatever equipment they wished to complete the task. All personnel assignments and strategy discussions were within the 15 minute time limit.

Results

Pilot testing of the team task demonstrated that it has the required qualities of a useful team task.

Four-person task with sufficient variation in group score to permit variations in group performance: The total scores for the 5 groups ranged from -2090 to +9060 with a mean of 3851 and a standard deviation of 3563. The devised point system thus allows for differences in group performance which may reflect underlying psychological factors. Observations made by the authors and comments during the debriefing of subjects indicate that leaders emerged at various times for each group. Thus the task apparently also allows the emergence of spontaneous leadership.

Group task that require the coordinated efforts of individuals working together: The rules (i.e.) that (a) objects weighing more than 50 pounds must be lifted by two people, (b) the operation of the pulleys requires two people, (c) people may do only one task at a time and not move from ship to ship, and (d) mounting and removing the nets between ships requires all four people to insure that working as a group is necessary for completion of the task. Observations made by the authors and debriefing comments indicate that groups with higher scores were more coordinated in their efforts than groups with lower scores. Prior experience in working in groups appears to increase the likelihood of a higher point score and greater coordination of group effort, but does not appear to be related to the degree of leadership exhibited by members of the group.

Susceptibility to disruption by stress: The team task has some stress built-in as a result of the time pressure and the negative point assignments. Additional stress was engendered in groups 1 to 3 because they were competing for a group prize. The performances of groups 1 to 3 showed far greater variation (standard deviation 4587) than those of groups 4 and 5 (standard deviation 247); this strongly suggests that the introduction of additional stress may disrupt the performance of some groups and may enhance the performance of others. Debriefing comments revealed that groups 1 to 3 were aware of competition, although members did not indicate that the competition was stressful to them.

Fits an acceptable task taxonomy: The team task was profiled during the reliability studies described above. The profile of this task, according to the experts, is as follows:

REALISTIC	INVESTIGATIVE	ARTISTIC	SOCIAL	ENTERPRISING	CONVENTIONAL
90%	0%	1%	0%	0%	9%

The task is seen as largely Realistic, requiring mechanical and technical skills. Consequently, it is a relatively pure and relatively prototypical Navy task.

Known familiarity and interest: Subjects in the reliability studies described earlier rated the team task for interest and familiarity.

PROFILE

Total Group

Familiarity	83% No	17% Yes
Interest	93% No	7% Yes

Experts

Familiarity	75% No	25% Yes
Interest	100% No	

Students

Familiarity	86% No	14% Yes
Interest	91% No	9% Yes

When working with this team task, interest and familiarity data should be collected from each team member so that these factors are known to the researchers. Curiously, although ratings indicated little interest in the task considered in the abstract, participants in the actual team task seemed quite enthusiastic. This may well have been due to the novelty of the situation rather than the inherent attractiveness of our task.

SECTION 7

OVERALL CONCLUSIONS

This report describes a series of studies conducted as part of a project the overall intent of which is to identify aspects of team performance subject to disruption by stress. This leads to an analysis of psychological factors that can disrupt team performance. The long range goal is to identify training procedures that might inoculate Naval teams against the effects of stress. In the short run, however, these questions lead inevitably to psychological factors affecting team performance. And that, in turn, leads to an examination of the effect of personality on team effectiveness. There is an extensive literature on this topic which seems to have ended in the middle 1960's. We suspect that researchers stopped investigating personality and team performance because, by about 1960, the research seemed not to be very cumulative. We attribute the lack of cumulative findings to two factors: (a) poor agreement among investigators regarding how to define personality; and (b) lack of a fully adequate methodology for classifying team tasks.

The emergence of the "Big Five" theory (Wiggins, 1973) essentially solves the first problem; personality can be defined in terms of five broad factors which we call Intellectance, Adjustment, Prudence, Ambition/Sociability, and Likeability. The classification research described in the first part of this report is intended to resolve the second problem. We conclude that team tasks can be adequately classified using Holland's (1985) type categories which, in turn, can be broken down into high and low technical demands, as suggested by Herold (1978).

With a taxonomy of personality traits <u>and</u> a taxonomy of team tasks, we can begin a series of composed group experiments in which task type is crossed by member characteristics. It still remains to develop a set of relatively pure tasks that are prototypical exemplars of each of the major task types.

We have developed the first of these--it is a simulation of a replenishment at sea exercise. This is an almost purely Realistic task--in Holland's parlance. Driskell, Hogan, and Salas (in press) suggest that performance on Realistic tasks is facilitated by the following pattern of personality characteristics: low to moderate Intellectance; high Adjustment; high Prudence, low Ambition/Sociability, average Likeability.

We currently plan a series of composed group studies designed to evaluate the foregoing speculation, the rationale for which is as follows. Low Intellectance is associated with a high tolerance for routine and a willingness to follow rules. High Adjustment is associated with the ability to fit in with a group. High Prudence is associated with the willingness to follow rules and take orders. Low Ambition/Sociability is associated with a willingness to cooperate and subjugate private aspirations to the goals of a group. We look forward to the opportunity empirically to evaluate these speculations which have implications for team composition and training.

According to the model just described, many of the stresses experienced by a group working as a Realistic task could result from incompatible personalities within the group rather than threats external to it. It is important to be able to separate these sources of stress in order to be able to isolate and deal with them. We see this research as contributing in a substantive way to the literature on team effectiveness as well as providing the Navy some practical guidelines for enhancing team performance in the rigors of the CBR environment.

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APPENDIX A

DESCRIPTION OF HOLLAND CLASSIFICATIONS

DESCRIPTION OF HOLLAND CLASSIFICATIONS

DIRECTIONS: Listed below are definitions for Holland's six classifications. READ EACH definition carefully, then proceed to the TASK PROFILE FORM. RATE each task ACCORDING TO THE DESCRIPTIONS BELOW.

<u>REALISTIC</u>: Includes activities that entail the EXPLICIT, ORDERED, or SYSTEMATIC MANIPULATION OF OBJECTS, TOOLS, MACHINES and ANIMALS. Tasks involve the CONSTRUCTION, OPERATION, MAINTENANCE, or REPAIR of things--machinery, buildings or equipment.
These tasks are PRACTICAL, PHYSICAL and CONCRETE and require mechanical ingenuity, persistence, and physical movement from place to place. Typical groups involved in Realistc tasks include construction crews, athletic teams and combat teams.

<u>INVESTIGATIVE</u>: Includes activities that entail OBSERVATIONAL, SYMBOLIC, SYSTEMATIC, and CREATIVE INVESTIGATION of physical, biological, and cultural phenomena IN ORDER TO UNDERSTAND AND CONTROL SUCH PHENOMENA. Tasks involve the GENERATION, EXPLORATION AND VERIFICATION OF NEW KNOWLEDGE --scientific, medical, artistic, or philogophical.
These tasks tend to be ABSTRACT or THEORETICAL, and require imagination, intelligence, and sensitivity to physical and intellectual problems. Typical groups involved in Investigative tasks include research teams, advisory committes, and problem-solving groups.

<u>ARTISTIC</u>: Includes AMBIGUOUS, FREE, and UNSYSTEMATIZED activities that entail the MANIPULATION OF PHYSICAL, VERBAL OR HUMAN MATERIALS TO CREATE ART FORMS OR PRODUCTS. Tasks involve the INVENTION, ARRANGEMENT and PRODUCTION of various products in accordance with certain rules of form.
Tasks may be PRACTICAL or THEORETICAL, and typically require the interpretation of feelings, ideas or facts in terms of a personal viewpoint.
Typical groups involved in Artistic tasks include musical groups, advertising teams, and architectural firms.

<u>SOCIAL</u>: Includes activities that entail the MANIPULATION OF OTHERS TO INFORM, TRAIN, DEVELOP, CURE, or ENLIGHTEN. Tasks involve TRAINING, ASSISTING, and SERVING OTHER PEOPLE.
Tasks tend to be APPLIED and require the ability to interpret and modify human behavior and an interest in caring for and communicating with others.
Typical groups involved in Social tasks include medical teams, coaching staffs, and community volunteer offices.

DESCRIPTION OF HOLLAND CLASSIFICATIONS (cont.)

ENTERPRISING: Includes activities that entail the MANIPULATION OF OTHERS TO ATTAIN ORGANIZATIONAL GOALS OR ECONOMIC GAIN. Tasks involve ORGANIZING, MOTIVATING, and PERSUADING OTHER PEOPLE.
Tasks tend to be GENERAL, OPEN-ENDED and APPLIED, and require directing, controlling, and planning the activities of others. Typical groups involved in Enterprising tasks include management teams, political advisory groups, and union organizing task forces.

CONVENTIONAL: Includes activities that entail the EXPLICIT, ORDERED and SYSTEMATIC MANIPULATION OF DATA TO ATTAIN ORGANIZATIONAL OR ECONOMIC GOALS. Tasks involve VIGILANCE, MONITORING, and RECORD KEEPING. Tasks tend to be ROUTINE, CONCRETE, and IMPERSONAL, and require prolonged attention to detail and systematic processing of verbal and mathematical information. Typical groups involved in conventional tasks include accounting teams, military watchstanding teams, and secretarial/clerical teams.

**NOTE: Group tasks or tasks involving people are NOT NECESSARILY SOCIAL tasks or have a Social component. Group tasks or tasks involving people can fall into ANY CATEGORY.

APPENDIX B

TASK PROFILE FORM

TASK PROFILE FORM

Directions:

--Read the task statement corresponding to the number to the far left column.

--Next, IDENTIFY which of the six categories (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) describes the task.

--Distribute 10 points according to HOW MUCH of the task falls into each category.

--Write the number (0-10) in the appropriate column. Each task should have a NUMBER IN EVERY COLUMN and the TOTAL POINTS MUST ADD UP TO 10.

--If you feel that some of the categories are not part of the task, please put a zero in that space.

Two examples are provided below:

Task #000 Design/build electronic components.

Task #999 Answer telephone and take messages.

Task#	Realistic	Investigative	Artistic	Social	Enterprising	Conventional
000	5	4	1	0	0	0
999	0	1	0	7	0	2

START HERE

Task#	Realistic	Investigative	Artistic	Social	Enterprising	Conventional

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TASK PROFILE FORM

Task#	Realistic	Investigative	Artistic	Social	Enterprising	Conventional

APPENDIX C
GRAPHIC REPRESENTATION OF THE EFFECTS OF SEX AND FAMILIARITY WITH HOLLAND'S CLASSIFICATION SYSTEM FOR HOLLAND'S SIX CATEGORIES

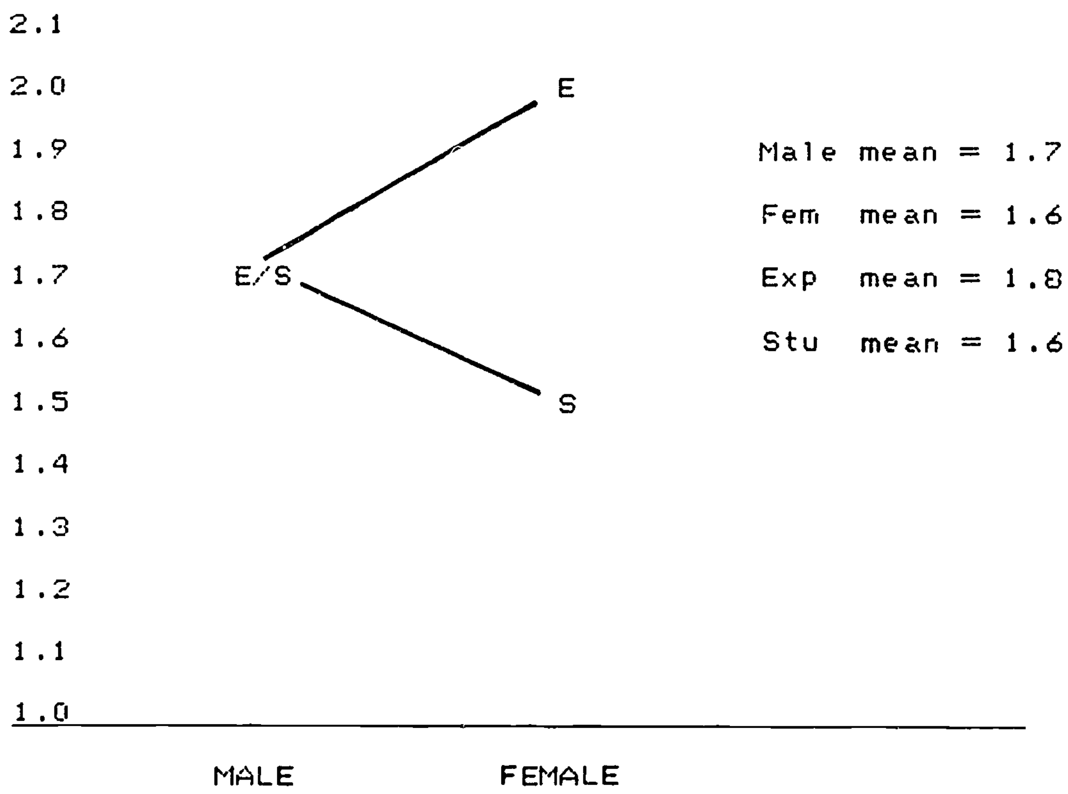
CONVENTIONAL

EXPERT/STUDENT STATUS AND SEX EFFECTS

Non-significant main effect for sex

Non-significant main effect for status

Significant effect of sex by status interaction, $p = .002$



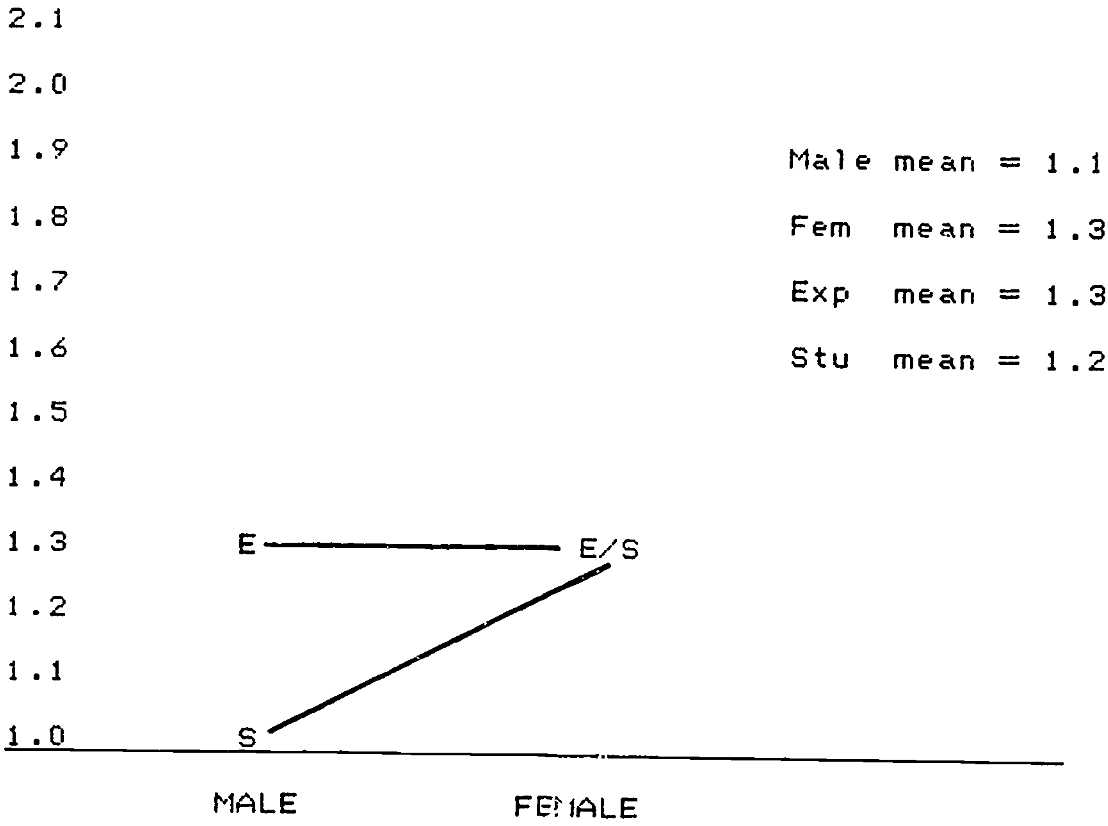
ENTERPRISING

EXPERT/STUDENT STATUS AND SEX EFFECTS

Significant main effect for sex, $\underline{p}$ = .001

Significant main effect for status, $\underline{p}$ = .013

Significant effect of sex by status interaction, $\underline{p}$ = .008



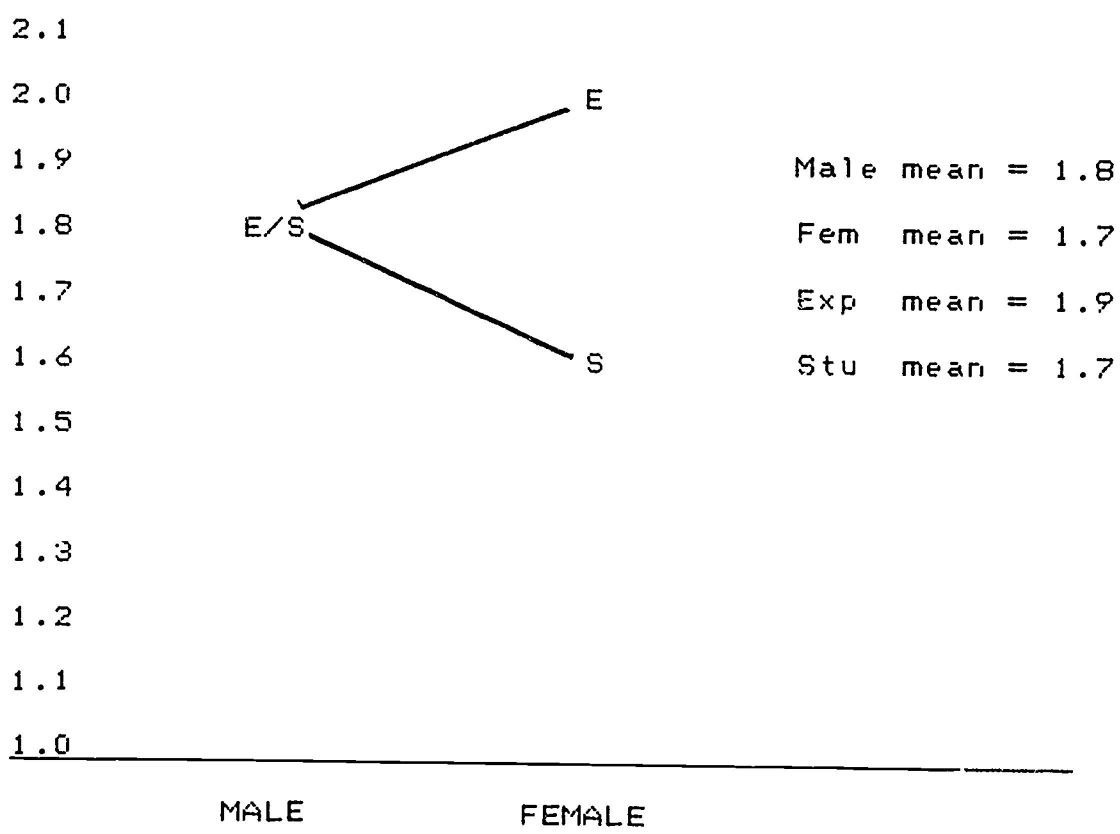
SOCIAL

EXPERT/STUDENT STATUS AND SEX EFFECTS

Non-significant main effect for sex

Significant main effect for status, p = .039

Significant effect of sex by status interaction, p = .010



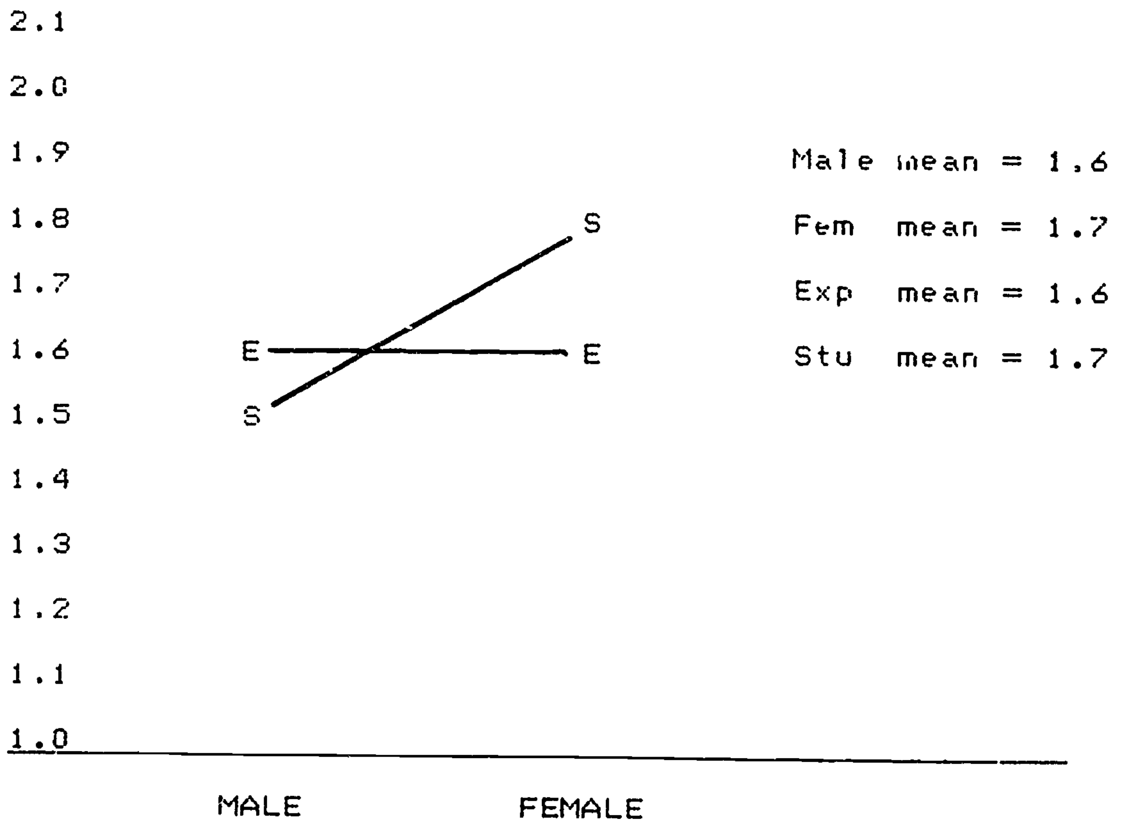
ARTISTIC

EXPERT/STUDENT STATUS AND SEX EFFECTS

Significant main effect for sex, $\underline{p} = .046$

Non-significant main effect for status

Non-significant effect of sex by status interaction



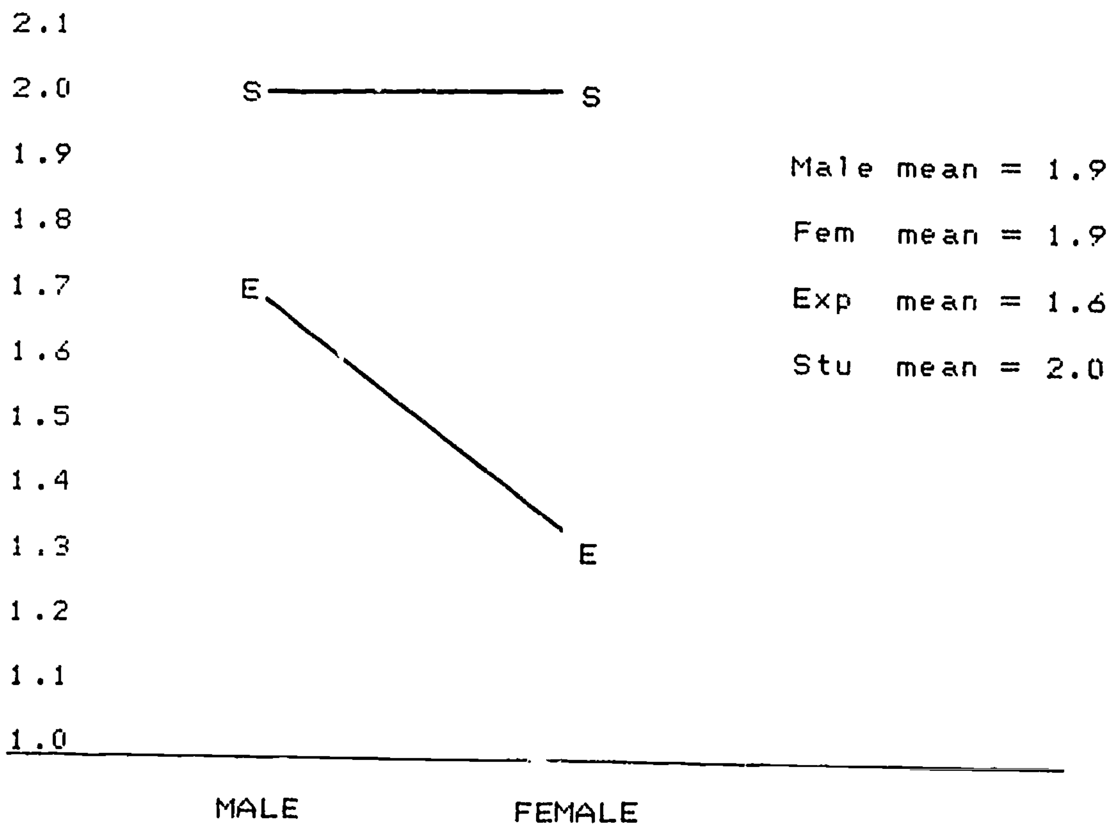
INVESTIGATIVE

EXPERT/STUDENT STATUS AND SEX EFFECTS

Non-significant main effect for sex

Significant main effect for status, p = .000

Significant effect of sex by status interaction, p = .002

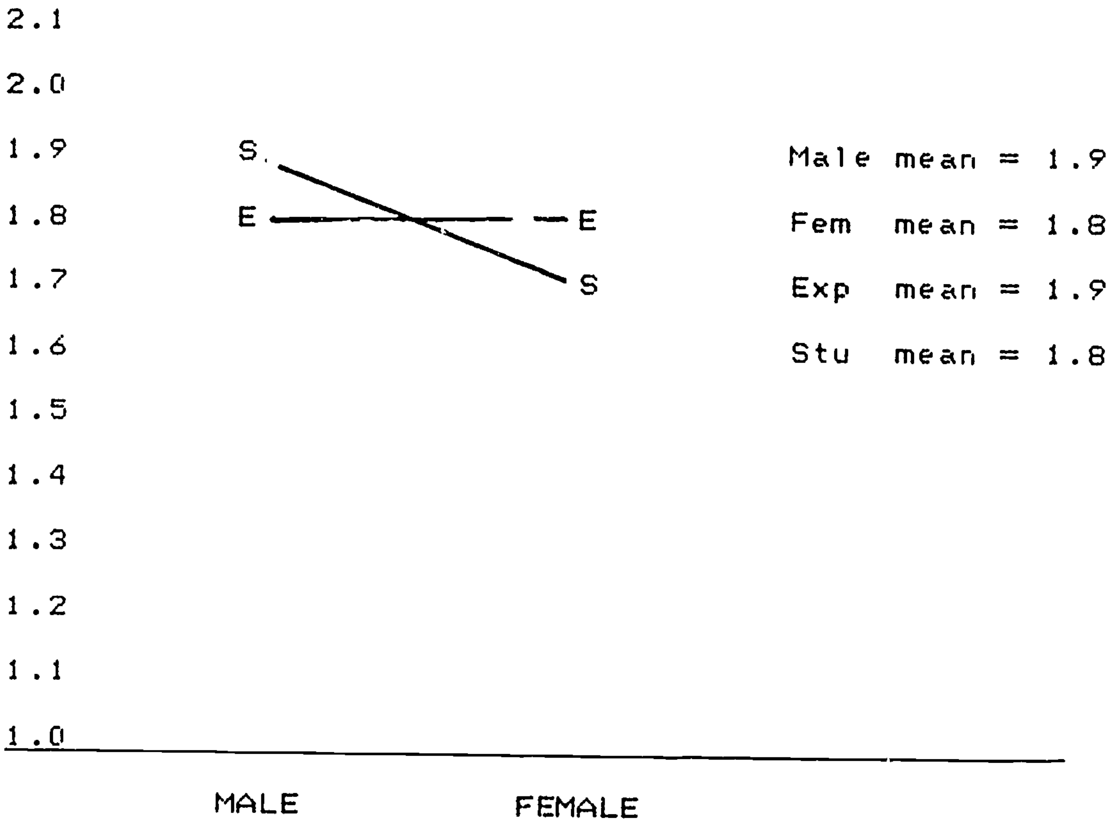


REALISTIC

EXPERT/STUDENT STATUS AND SEX EFFECTS

Non-significant main effects for sex and status

Non-significant effect of sex by status interaction



APPENDIX D
EXAMPLE TASK AND RESULTANT PROFILE FOR HOLLAND'S SIX CATEGORIES

REALISTIC

Example Task:

Cut, strip, and load pine logs onto the waiting truck. Observe all safety precautions.

PROFILE

Real	Invest	Art	Soc	Enterp	Conven
86%	4%	1%	3%	2%	4%

INVESTIGATIVE

Example Task:

Design a research study to determine whether immigrants into the U.S. make an overall positive contribution to the economy by becoming successful entrepreneurs.

PROFILE

Real	Invest	Art	Soc	Enterp	Conven
2%	65%	7%	6%	9%	11%

67

ARTISTIC

Example Task:

Do the graphics to advertise the upcoming performance of the Broadway musical "Cats". Design and draw the graphics for posters, brochures, and newspaper advertisements.

PROFILE

Real	Invest	Art	Soc	Enterp	Conven
4%	5%	77%	6%	7%	1%

68

SOCIAL

Example Task:

Take care of the personal and hygiene needs of elderly patients in a nursing home. Assist patients with bathing, dressing, feeding, and moving around as necessary.

PROFILE

Real	Invest	Art	Soc	Enterp	Conven
18%	2%	0%	72%	4%	4%

69

ENTERPRISING

Example Task:

Two work teams are candidates for the same project--Your group is one of the teams. The project will be a challenge, but could entail promotional and bonus opportunities. Present your case such that your team will be chosen.

PROFILE

Real	Invest	Art	Soc	Enterp	Conven
3%	15%	9%	17%	52%	4%

CONVENTIONAL

Example Task:

You and 3 others will be given a stack of completed questionnaires. Transcribe the data (according to a prescribed format sheet) onto data sheets. Punch the data into the designated computer account. Verify the accuracy of the numerical data.

PROFILE

Real	Invest	Art	Soc	Enterp	Conven
12%	12%	0%	3%	3%	70%

APPENDIX E

DESCRIPTION OF HOLLAND-RELATED SKILL TYPES

DESCRIPTION OF HOLLAND-RELATED SKILL TYPES

Listed below are the definitions for Holland-related skill types. READ EACH definition carefully, then proceed to the TASK PROFILE FORM. RATE each task ACCORDING TO THE DESCRIPTIONS BELOW.

MECHANICAL-TECHNICAL

Manual, mechanical, agricultural, electrical, and technical competencies.

Ability or proficiency in the manipulation of objects, tools, machines and animals.

INTELLECTUAL-ANALYTICAL

Scientific and mathematical competencies.

Ability to learn, understand or cope with a new situation.
Ability or proficiency in breaking up a "whole" into its parts to find out their nature.
Ability to carefully examine the constituents of anything complex.

AESTHETIC-IMAGINATIVE

Artistic competencies in language, art, music, drama, and writing.

Ability or proficiency in forming mental images of what is not present.
Ability to create, inspire or guide new ideas.
Ability to be appreciative of or responsive to beauty and art.

INTERPERSONAL-SOCIAL

Human relations competencies such as interpersonal and educational competencies.

Ability or proficiency in forming cooperative and interdependent relationships with others.
Ability to seek or enjoy companionship or social intercourse.
Ability to willingly work with others for a common end.

MANIPULATIVE-PERSUASIVE

Leadership, interpersonal and persuasive competencies.

Ability or proficiency in causing someone to do or believe something, especially by reasoning and urging.
Ability to manage artfully or shrewdly.
Ability to control, manage or play upon by artful, unfair or insidious means, especially to one's advantage.

ATTENTION TO DETAIL

Clerical, computational, and business system competencies.

Ability or proficiency in dealing with things item by item.
Ability to give heed or notice to small parts or items.

APPENDIX F

TASK PROFILE FORMS FOR HOLLAND DERIVED SKILLS AND INTERST AND FAMILIARITY

TASK PROFILE FORM

Directions:

-- Read the task statement corresponding to the number in the far-left column.

-- Next identify which of the 6 skill types (technical, intellectual-analytical, imaginative-aesthetic, social, persuasive-manipulative and attention to detail) are required to perform the task.

-- Distribute a total of 10 points according to the amount of skill necessary.

-- Write the number (0-10 points) in the appropriate column which best describes the type and degree of skills necessary to perform the task. Each task should have a NUMBER IN EVERY COLUMN.

-- The points assigned MUST ADD UP TO 10. If you feel that some of the skill categories are not required by the task, please put a zero in that space. Two examples are provided below.

Task #000 Design/build electronic components.

Task #999 Answer telephone and take messages.

Task #	Mechanical-Technical	Intellectual-Analytical	Aesthetic-Imaginative	Interpersonal-Social	Manipulative-Persuasive	Attention to Detail
000	5	3	1	C	0	1
999	0	0	0	7	0	3

START HERE:

Task #	Mechanical-Technical	Intellectual-Analytical	Aesthetic-Imaginative	Interpersonal-Social	Manipulative-Persuasive	Attention to Detail

TASK PROFILE FORM

Directions:

-- Using the same set of tasks, answer the following questions:

1) I am familiar with this task. (yes or no)

2) I find this task interesting. (yes or no)

-- Check the appropriate "yes" or "no" response.

Task #	Familiarity Yes	Familiarity No	Interesting Yes	Interesting No
000		X		X
999	X		X	

STAR~ HERE:

Task #	Familiarity Yes	Familiarity No	Interesting Yes	Interesting No

77

APPENDIX G

THREE EXAMPLE TASKS AND RESULTANT PROFILES FOR HOLLAND DERIVED SKILLS

FIGURE 1

EXAMPLE TASK FOR HIGH INTELLECTUAL SKILLS:

Solve for x:

$$x + yz = \frac{4(x + y + z)}{2x + 3y + 5z} + yz$$

PROFILE:

MECH	INT	IMAG	SOC	MANIP	ATTN
9%	73%	1%	0%	0%	17%

TASK INTEREST: Yes (56%) No (44%)

TASK FAMILIARITY: Yes (97%) No (3%)

NOTE: The intellectual dimension was the least reliably rated.

FIGURE 2

EXAMPLE TASK FOR HIGH ATTENTION TO DETAIL SKILLS:

Stamp Library books being checked out. Replace check-out cards into returned books. Reshelve library books, documents and periodicals in the proper locations.

PROFILE:

MECH	INT	IMAG	SOC	MANIP	ATTN
10%	10%	5%	5%	5%	65%

TASK INTEREST: Yes (26%) No (74%)

TASK FAMILIARITY: Yes (63%) No (37%)

NOTE: Ratings for the Attention to Detail dimension had moderate reliability.

FIGURE 3

EXAMPLE TASK FOR HIGH SOCIAL/MANIPULATIVE SKILLS:

Solicit charity contributions for the United Way from the general public in a large shopping mall.

PROFILE:

MECH	INT	IMAG	SOC	MANIP	ATTN
0%	2%	11%	49%	36%	2%

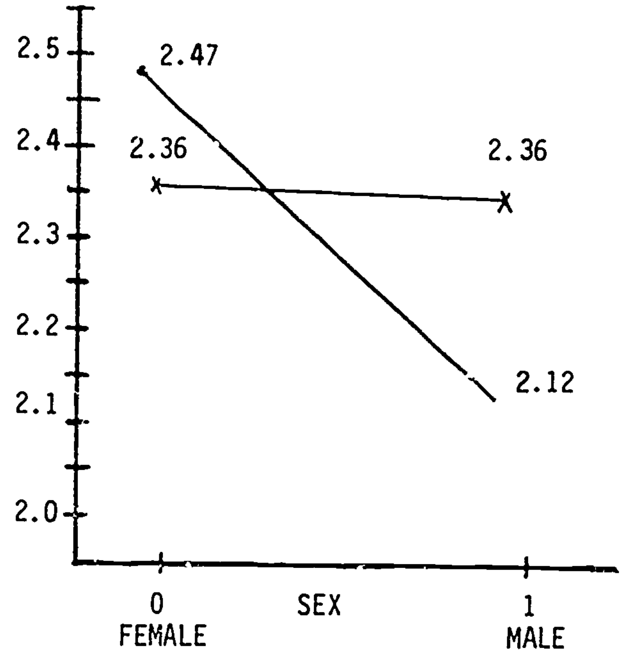
TASK INTEREST:	Yes (28%)	No (72%)
TASK FAMILIARITY:	Yes (69%)	No (31%)

NOTE: The social dimension was one of the most reliably rated dimensions. The manipulative dimension was rated with moderate reliability.

APPENDIX H

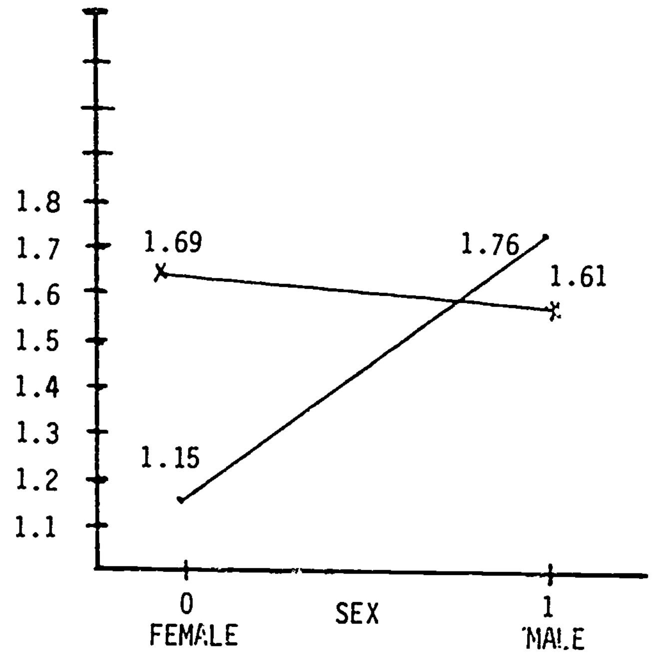
A GRAPHIC REPRESENTATION OF THE EFFECTS OF SEX AND FAMILIARITY WITH HOLLAND SYSTEM ON THE HOLLAND DERIVED SKILLS AND INTEREST AND FAMILIARITY

MECHANICAL



FEM 2.39
MALE 2.26
EXP 2.26
NAIVE 2.36

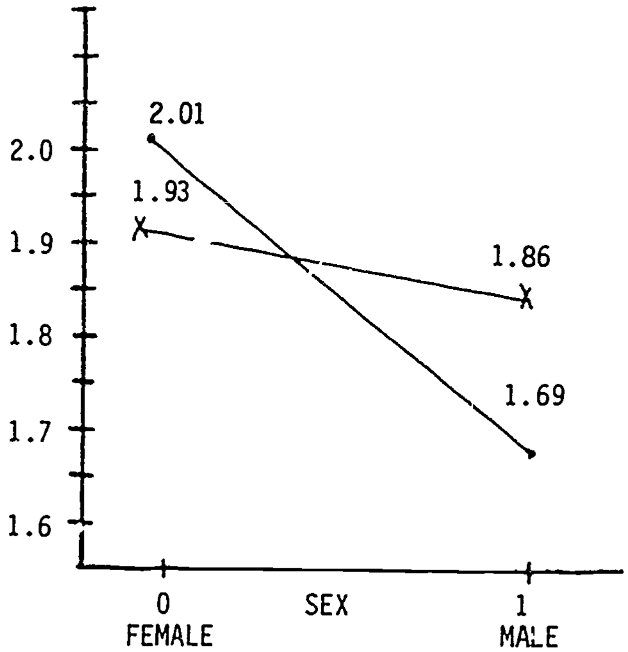
INT.



FEM 1.58
MALE 1.67
EXP 1.51
NAIVE 1.66

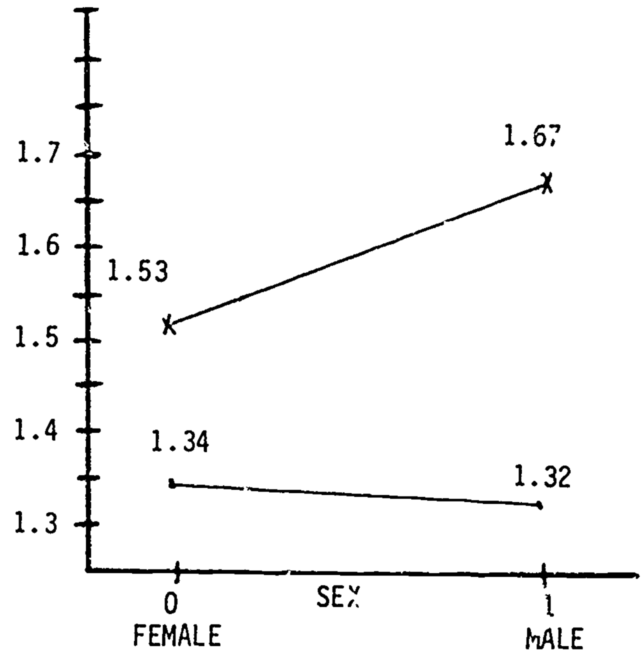
p = .046
p = .000

IMAG



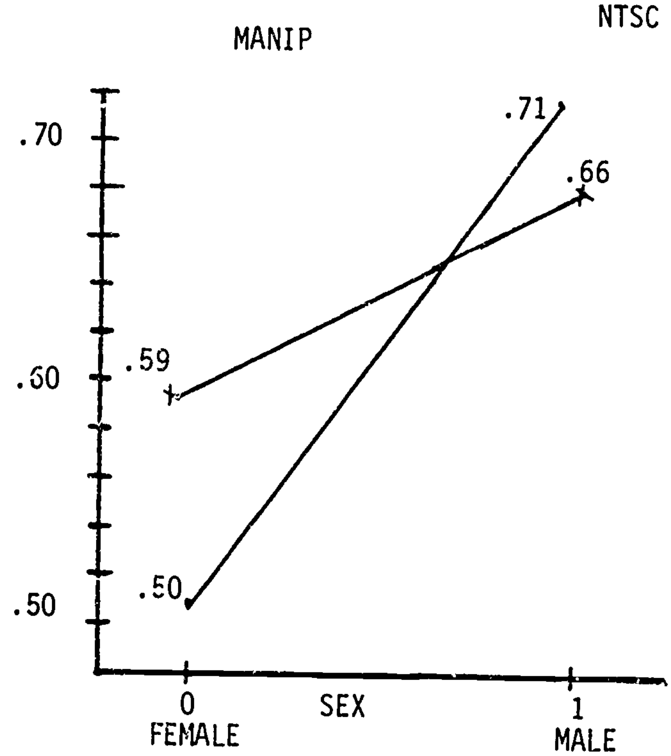
FEM 1.95
MALE 1.79
EXP 1.83
NAIVE 1.91

SOC



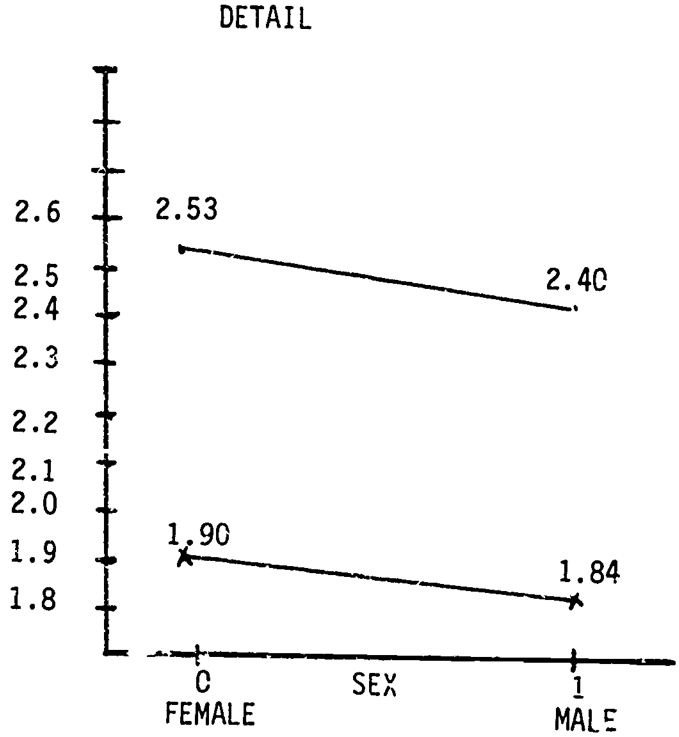
FEM 1.49
MALE 1.52
EXP 1.33
NAIVE 1.58

p = .004



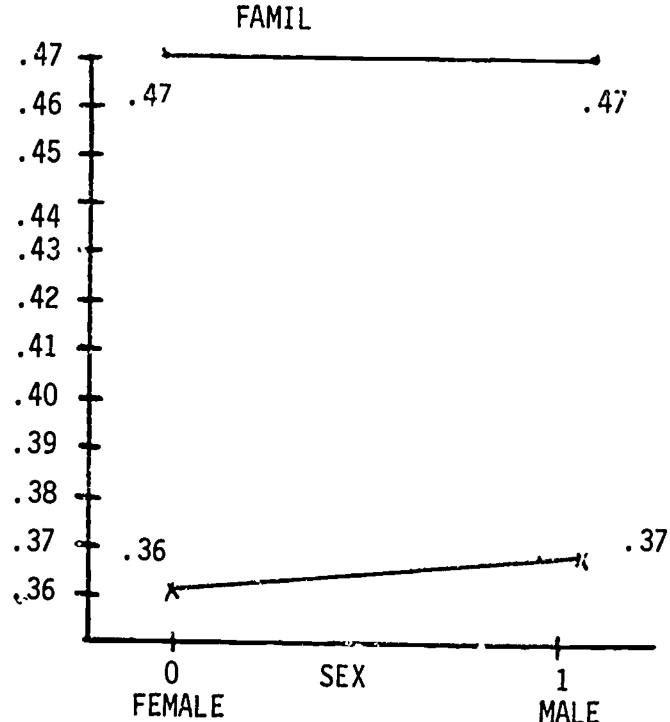
FEM .57
MALE .68
EXP .62
NAIVE .61

p=.037

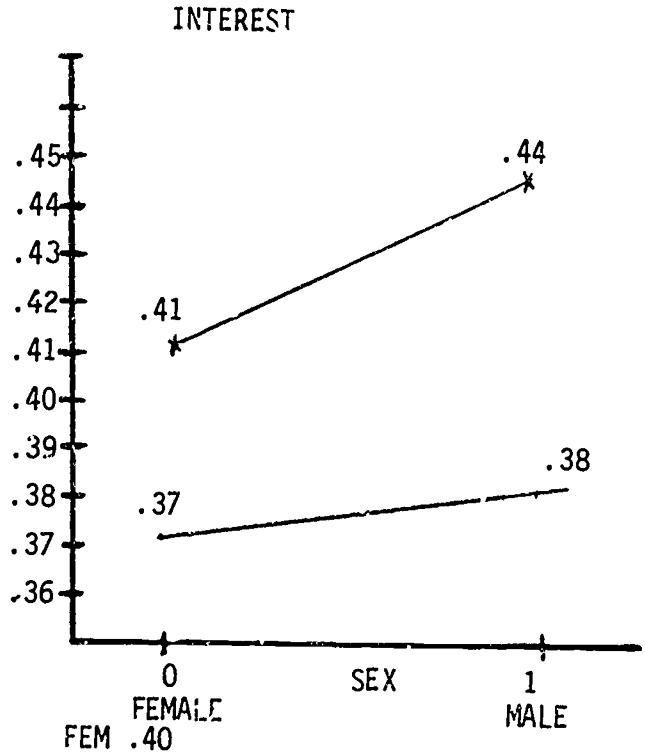


FEM 2.03
MALE 2.07
EXP 2.45
NAIVE 1.88

p=.000



FEM .38
MALE .41
EXP .47
NAIVE .36



FEM .40
MALE .42
EXP. .38
NAIVE .42

APPENDIX I

DESCRIPTION OF HEROLD'S MODEL

DESCRIPTION OF HEROLD'S MODEL

Tasks place two general types of demands on a group or individual--**TECHNICAL** and **SOCIAL**. These demands may vary from **SIMPLE** to **COMPLEX** or from easily satisfied to difficult to satisfy.

TECHNICAL DEMANDS refer to the skills and knowledge necessary to accomplish the task.

SOCIAL DEMANDS refer to the types of interactions among the members that the task requires.

Technical demands are SIMPLE OR LOW when the PROCEDURES or RESOURCES necessary are OBVIOUS to members and EASILY AVAILABLE.

Examples:

- -Pushing a stalled car.
- -Passing buckets of water in a fire brigade.
- -Using electronic data processing equipment to supply needed data.

Technical demands are COMPLEX OR HIGH when READY SOLUTIONS OR MEMBER RESOURCES are NEITHER AVAILABLE NOR OBVIOUS, and a SEARCH must be performed to find an appropriate way of meeting them.

Examples:

- -Creating new special effects for a movie.
- -Assessing the cost of various technological changes.

Social demands are SIMPLE OR LOW when each member can work on a different part of the task and LITTLE INTERACTION is required; OR when the required INTERACTION, even if considerable, IS MUNDANE and NOT LIKELY TO CAUSE INTERPERSONAL DIFFICULTIES.

Examples:

- -Tug-of-war.
- -Surveying a construction site.
- -Digging a ditch.

Social demands are COMPLEX OR HIGH when the task requires EXTENSIVE and POTENTIALLY PROBLEMATIC INTERACTION among members and the INTERACTION PROCESS SHAPES and DETERMINES the END PRODUCT. When a task is emotionally charged or has serious consequences. It is particularly likely to be high in social difficulty.

Examples:

- -Jury deciding a verdict.
- -School board deciding on a desegration plan.

TECHNICAL DEMANDS refer to the skills and knowledge necessary to accomplish the task.

SOCIAL DEMANDS refer to the types of interactions among the members that the task requires.
****

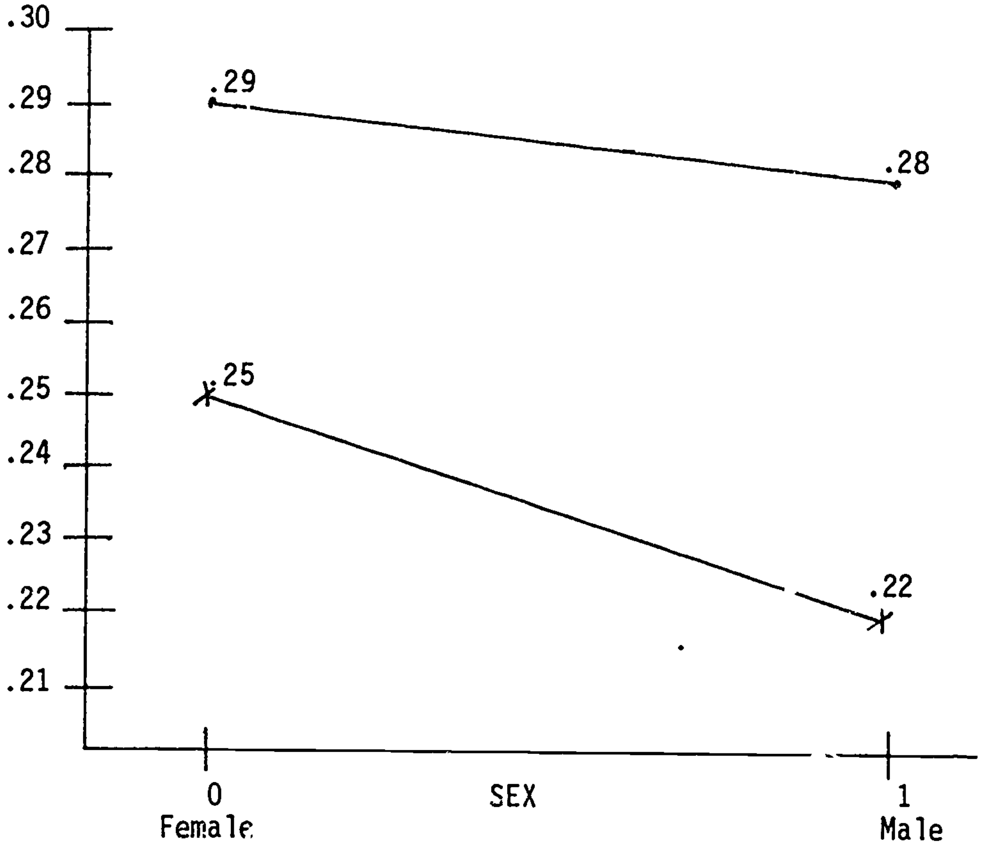
		COMPLEXITY OF TECHNICAL DEMANDS	
		LOW	HIGH
COMPLEXITY OF SOCIAL DEMANDS	LOW	Both technical and social demands are simple and routine Example: -Routine record keeping. -Pushing stalled car. -Routine maintenance.	Social relations are routine but technical demands are high. One best alternative is not obvious and easily agreed upon. Example: -Conducting a feasibility study. -Track relay team running a race
	HIGH	Task is technically simple, but interpersonally problematic. Form of response is based mostly on social group process. Example: -Agreeing upon a budget. -Deciding how to distribute funds.	Both technical and social demands are complex. One best alternative is not obvious and easily agreed upon. Example: -Revising the U.S. tax system. -Producing a creative product.

APPENDIX J

GRAPHIC REPRESENTATION OF THE EFFECTS OF SEX AND FAMILIARITY WITH HOLLAND SYSTEM ON HEROLD'S TASK DEMANDS

• = 1 EXP
X = 2 NAIVE

LTLS

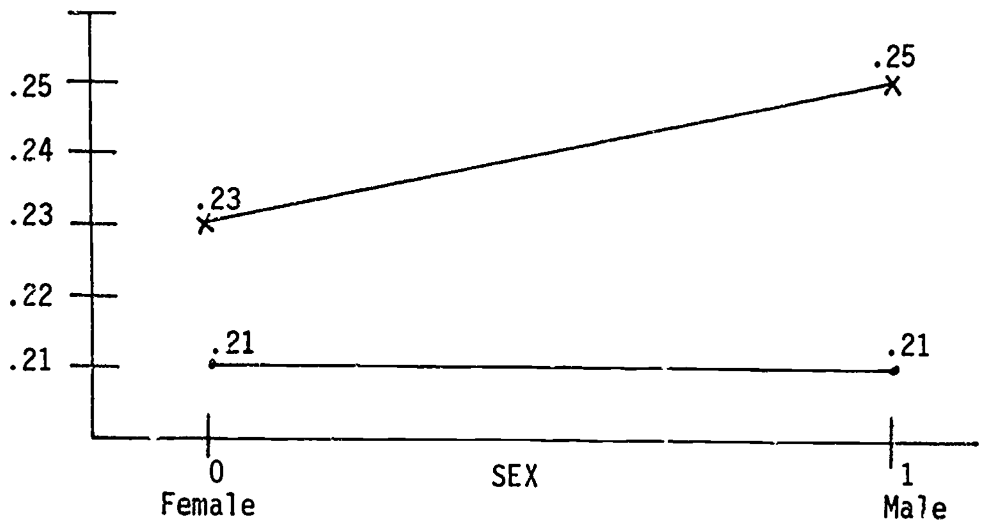


FEM .26
MALE .24
EXP .28
NAIVE .24

M.E. STATUS

p < .005

LTHS

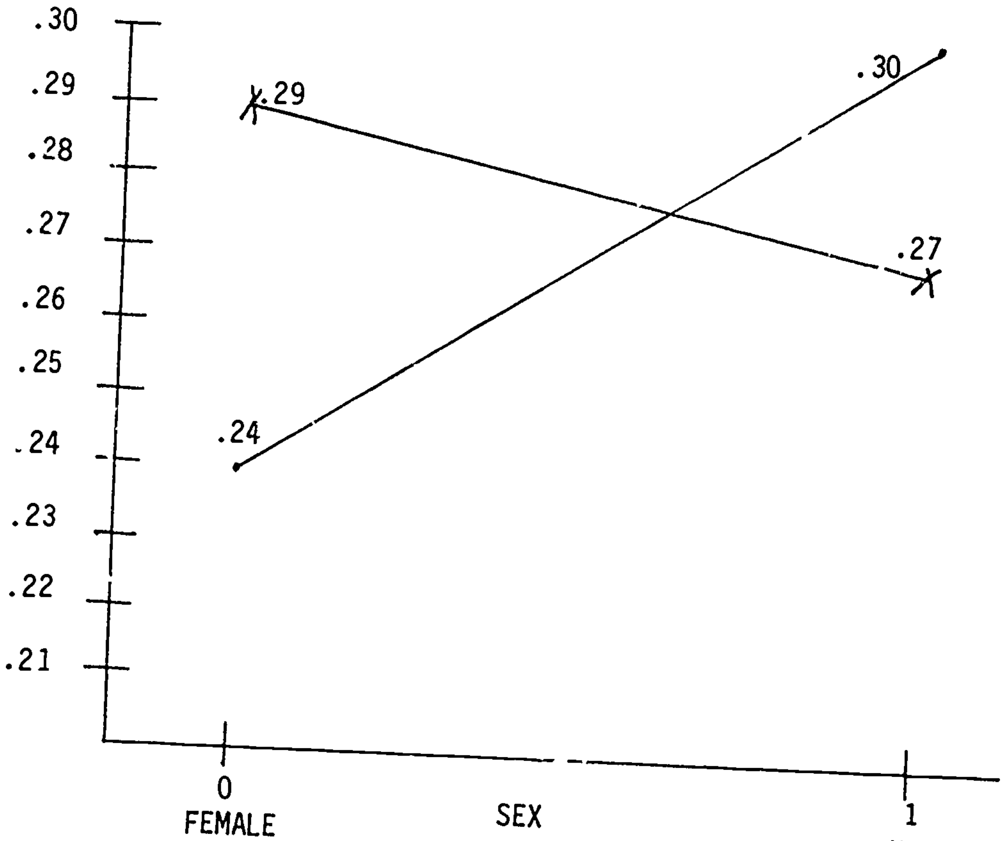


FEM .23
MALE .24
EXP .21
NAIVE .24

88

• = 1 EXP
x = 2 NAIVE

HTLS

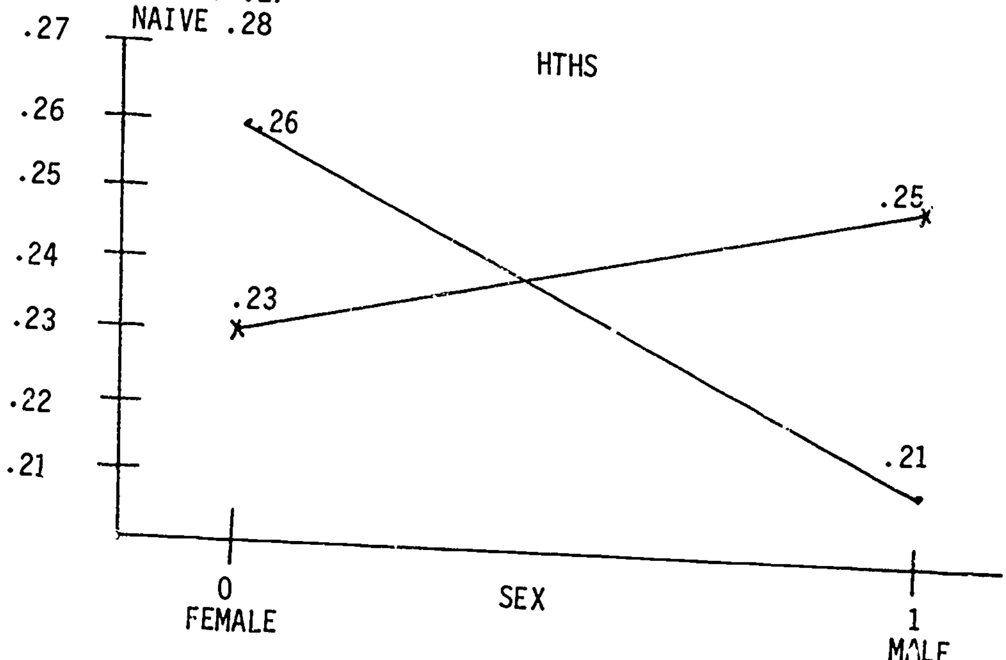


I.E.

p = .037

FEM .28
MALE .28
EXPERT .27
NAIVE .28

HTHS



p = .05

FEM .23
MALE .24
EXP .23
NAIVE .24

89

APPENDIX K

INSTRUCTIONS FOR TEAM TASK

Replenishment at Sea

You and your group will simulate a common Navy task in which individuals on a supply ship transfer supplies to another ship while at sea. The tables in the room represent the two ships: Ship A is the supply ship loaded with cargo in the form of blocks, wheels, and metal bars. Ship B is the other ship. There are two methods of transferring the cargo: the large orange crane, and the towers equipped with pulleys and ropes. Two nets are provided which you may attach between the two ships to prevent losing cargo during the transfer.

Objective: Transfer cargo from Ship A to Ship B within the time limit while achieving the highest point score possible. The group with the highest point score wins a prize. Note that transferring the more difficult cargo gains more points for your group than transferring the easier cargo, and that there are penalty points for making errors and failing to follow safety rules.

Time limit: 15 minutes

Rules:

Personnel:

YOU MAY: 1. Assign team members to either ship.

2. Communicate verbally between ships.

LIMITATIONS

3. Lifting, attaching, and operating:

1 person - may lift 50 lbs USING TWO HANDS

- may lift EMPTY platforms, buckets, and nets USING TWO HANDS

- may attach crane and pulley hooks WITHOUT LIFTING

- may operate or lift ONLY ONE THING at a time

2 people - must lift cargo weighing more than 50 lbs USING AT LEAST ONE HAND EACH

4 people - must attach netting between ships Attachment of nets is OPTIONAL

4. Reaching between ships is prohibited

Equipment/Cargo:

1. Equipment weight limits are marked on the equipment. Pulleys can lift up to 250 lbs crane can lift up to 400 lbs.

2. Weight of cargo is marked on cargo. TIRES weight 300 lbs.

3. Cargo must be transferred by platform, bucket, net, or by itself USING either pulleys or crane.

4. Unloading: Unload cargo to any area of Ship B

   DO NOT stack heavier cargo on lighter cargo

5. Dropped cargo: You MAY retrieve cargo dropped in net; cargo dropped on floor is LOST.

When cargo transfer is finished:

1. The original number and type of platforms and nets must be on Ship A and Ship B.

2. All cargo must be unloaded.

3. Nets between ships must be removed

A 10, 5, and 1 minute warning will be provided.

Following our demonstration of the equipment, you will have 5 minutes to examine the equipment and ask any questions. You may not practice using the equipment or make personnel assignments or plans during the 5 minutes.

Point system:

Gain Points:

Wheel	+300 each
125 Triangle	+200 each
125 Steel bar	+200 each
150 Block	+175 each
100 Cylinder	+150 each
100 Block	+100 each
50 Cylinder	+100 each
75 Block	+75 each
50 Block	+50 each

Lose Points:

Lost cargo	-1500 each
Break Equipment	-1500 each
Violate equipment weight limitations	-500 each
Illegal equipment operation (personnel)	-100 each
Illegal cargo transfer (e.g., throwing)	-100 each
Illegal reaching	-50 each
Illegal lifting (personnel)	-50 each
Illegal stacking	-50 each
Illegal personnel transfer	-25 each
Illegal netting attachment	-25 each

Cargo remains on platform	-50 each, no points for cargo on platform
Netting remains between ships	-50 each
Platforms/net left on wrong ship	-50 each

Bonus Points!!

All cargo transferred within time limits	+500
Finish without penalty points	+1500
Finish early (all cargo transferred)	+50 for each

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